LABORATORY UNIT 3
BIODIVERSITY II: FUNGI AND PLANTS

PART 1: KINGDOM FUNGI

Fungi are a large and diverse group of organisms that include molds, mildews, yeasts, rusts, puffballs and mushrooms. Long thought to be a degenerate form of plants that had lost their photosynthetic ability, fungi have recently been placed in a separate kingdom, containing four or five phyla, based on a number of distinct features. There are approximately 100,000 described species of fungi, but the actual number is probably much larger. Fungi include some of the oldest living organisms, one estimated to have been growing for at least 2600 years. Fungi include single celled forms up to the largest living thing on the planet, a network covering almost 900 hectares (over 2200 acres) and weighing hundreds of tons.

Most of you are familiar with mushrooms, but they are only the above ground portions of a much larger organism. Yeasts consist of single cells, but most fungi are multicellular. Fungal cell walls contain a strong, flexible polysaccharide called **chitin**, the same material found in the exoskeleton of arthropods. The body of a typical fungus is composed of branched filaments called **hyphae** (sing. **hypha**). Hyphae are fused into a net-like mesh called a **mycelium** (pl. **mycelia**).

In most fungi, the hyphae are divided into cells by cross walls called septa. The septa have pores that allow cytoplasm to flow between cells. Hyphae grow by adding compartments at the tip.

Fungi are heterotrophic; they are dependent on external sources for carbon compounds. Consequently, all live as saprophytes, parasites or as symbionts with protists, plants or animals. Parasitic have specialized hyphae that penetrate a host plant or animal and absorb nutrients directly from the host's cells. Some symbiotic fungi invade the roots of plants and facilitate the uptake of nutrients from the soil. Lichens are the most conspicuous examples of the mutualistic relationship between a fungus (usually an ascomycete) and an alga or cyanobacterium.

Lichens are extremely tolerant of harsh conditions. They typically grow on tree bark, rocks or bare ground. The ability to grow on bare rock gave rise to their common name "pioneer plants" even though they are not true plants. Lichens accelerate weathering by dissolving rock and preparing the substrate for seeds of rooted plants. Lichens are most common in extreme environments such as dormant volcanoes, high mountains, the Arctic and Antarctic, tropics and intertidal zones. They can withstand, in fact they require, alternate wet and dry periods. Despite their hardiness, lichens are very sensitive to environmental pollutants, especially sulfur dioxide from the burning of fossil fuels.

Scientists have long classified lichens based on their growth pattern: crustose (crust-like), foliose (leafy) or fruticose (bushy). The thallus makes up the majority of the lichen and is involved with growth, metabolism and photosynthesis. The reproductive portion usually has a distinct appearance and produces spores that germinate to form fungal hyphae. Lichens can also reproduce by fragments consisting of at least one algal cell and surrounding fungal hyphae that are dispersed by wind or water. Lichens are famous for their very slow rate of growth. Several studies of lichens found on gravestones and monuments document growth of only a few millimeters in a century.

Because of the chitinous cell walls, fungi cannot ingest food particles. Instead, the hyphae

secrete powerful digestive enzymes, called **exoenzymes**, into the environment that break down complex molecules into simple organic compounds that can be absorbed and used by the fungi. Hyphae are never more than several micrometers thick; thus, they have a high surface area-to-volume ratio for efficient absorption. Cytoplasmic streaming permits the absorbed materials to be easily distributed to nonabsorbing regions.

Fungi are important components of decomposer ecosystems. The digestive activity of fungi releases inorganic compounds and CO_2 that would otherwise be tied up in dead organic matter and unavailable to other organisms.

Reproduction can be sexual or asexual. Cell division in fungi is unusual in that the nuclear membrane does not fragment and reform. The spindle forms inside the nuclear membrane and the chromosomes move to opposite poles of the nucleus. The nucleus then divides into two. Asexual reproduction can occur by the fragmentation of hyphae with each fragment forming a new mycelium or by hyphae differentiating into sporangia that produce spores. The familiar mushrooms or puffballs are conspicuous spore producing structures. Sexual reproduction occurs by the fusion of gametes or specialized reproductive hyphae.

Some fungi can produce extremely powerful toxins. Some fungi that attack food crops and produce carcinogenic toxins called aflatoxins that can be lethal in concentrations as low as a few parts per billion. Not all fungal toxins are detrimental to humans. The first antibiotic was isolated from the mold *Penicillium*.

Yeasts

Other microbes found commonly in air, water, and terrestrial habitats are the small forms of the Kingdom **Fungi**. Perhaps the most common representatives are the yeasts and molds, which are placed in the Phylum **Ascomycota**. This phylum gets its name from the fact that several resistant spores are formed under adverse conditions inside a specialized cell, which is shaped like a sac. In Greek the word for a goatskin sac is "askos"; hence, the origin of the term "sac-fungus".

Yeasts are considered both harmful and beneficial. Harmful effects are when they infect us or our foods, causing decay—what we refer to as "rot" or "spoilage"—to set in. Benefits come mainly when various fungi are consumed directly for food or yeasts are used in baking or to ferment sugars into alcohol and carbon dioxide gas. The alcohol is a waste product of yeasts; but is consumed by us in various beverages. Beer and wine are made from wild strains of yeast by indigenous peoples on all inhabited continents. Bakers use the carbon dioxide gas released by living yeast to make dough rise. In this case, the yeast serves as a leavening agent. Over the last few centuries yeast strains have been grown and selected by humans for improved ability to do specific tasks, such as making more alcohol or producing more gas than the wild types.

Materials:

(per classroom)

- Blank slides and cover slips
- Yeast suspension (1 package [= 1 tsp.] of dried yeast in 300 ml of a 10% glucose solution, made up ~1 day in advance in flask with cotton stopper.)
- Several plastic pipettes
- Methylene blue solution

1. To see yeast cells, make a wet mount of a drop of material from the yeast suspension. Examine the material using a compound microscope.
2. Make a drawing and use it in part to describe the form, size, color, and internal structure of the yeast cells. Include an illustration of budding.
3. In addition, on your slide do you see an **ascus** (plural asci), which is a round yeast cell containing four **ascospores**? If so, be certain that your partner and other students see it.

Examine the additional demonstration material on fungi and answer the questions on your worksheet.

PART 2: KINGDOM PLANTAE

The Kingdom Plantae comprises a large group. With over 300, 000 species known to science, the plant kingdom is second only to the animals in species diversity. Plants are a remarkably diverse group of organisms. They are, with few exceptions, autotrophic (photosynthetic), multicellular and have cell walls that contain cellulose. The life cycle of all members of the plant kingdom are variations on the alternation of generations. Review the generalized life cycle on page 602 in your textbook and be familiar with the major stages.

The major groups of plants are the bryophytes, ferns and fern allies, gymnosperms, and angiosperms or flowering plants. These groups are distinguished by morphology, life cycle, the presence or absence and organization of vascular tissues. In this laboratory period you will examine the gross and microscopic anatomy of representatives from each of these groups and compare the life cycles using the lecture text and demonstration materials presented in lab.

Vascular Tissues

Although all eukaryotic cells have much in common, there are some major differences in structure and function among the various kingdoms. In contrast to animals, plants have their cells encased within **cell walls**. Also, in contrast to animals, plants do not precisely regulate the solute concentrations in the **extracellular fluids** that bathe their living cells. Many biologists use these differences to imply that plants are not physiologically sophisticated or that plants are primitive relative to animals. Quite the opposite is true. Plants are physiologically sophisticated and they are highly derived. The bottom line is that plants are as successful as animals and both kingdoms share a common genetic ancestor dating back about 1.58 billion years; they just have taken rather different adaptive paths to cope with living on Earth. Work in groups of two.

As indicated in your lecture text, a major adaptation that enabled plants to grow tall in the air on dry land and to assume the typical forms we see today is the advent of a supportive skeletal system. The skeletal system is composed of elongate cells that have thickened cell walls.

Two major types of cells are used for support. Both are dead when fully matured. Figure 3.1 shows the side-view of tracheids.

1. **Sclerenchyma fibers** are long cells that are very flexible since their thick cell walls are filled with a natural plastic, called lignin, into a matrix of cellulose microfibers. Not only are individual fiber cells very long, but also they often are glued to one another end-to-end to form long threads. This is the source of the natural fibers that humans weave into cloth or rope (i.e., linen, sisal, and hemp). Fibers can be clumped together to form

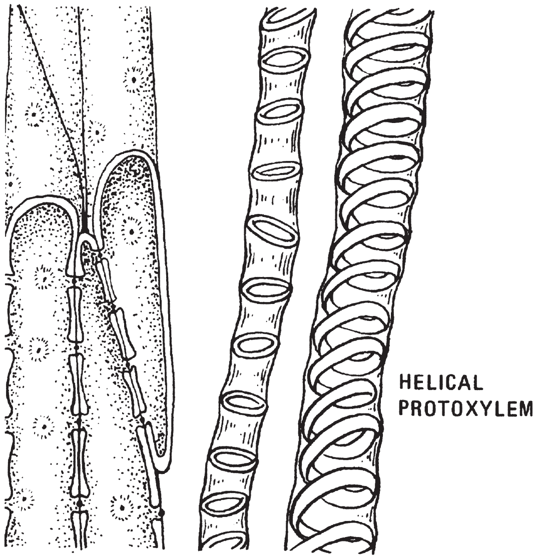

Figure 3.1

bundles in the shoot or they can be organized into distinct layers, such as a circular band just inside the epidermis of corn and asparagus shoots that we call the "rind," or a "sheath" around a vascular bundle in the stem.

2. **Xylem cells** of various sizes and shapes provide both support and conduction of watery sap from roots up to the leaves. Xylem cells along with **phloem cells** comprise the **vascular system** of higher plants. Cell walls of xylem also are thickened and impregnated with lignin. The softwood of pines is primarily composed of millions of xylem cells called **tracheids**. Tracheids are huge cells that you can see with the naked eye. They are approximately 0.1 mm in diameter and from 4 to 50 mm in length. After viewing these cells, its no wonder that they act like tiny soda straws, drawing water into dry wood. In monocots like corn the xylem is found in bundles dispersed throughout the stem. Sclerenchyma fibers are also present around each bundle.

As you examine the microscope slides of representatives from the different groups of plants, note the type and distribution of the vascular tissues.

Bryophytes

Bryophytes include mosses, liverworts and hornworts. They are the most primitive group of the terrestrial plants. All are green, have short root-like structures called rhizoids and may have parts that resemble stems or leaves. Bryophytes lack specialized vascular tissues that transport materials from the "roots" up through the plant "shoot". The absence of vascular tissues and necessity of free water for successful reproduction restricts the distribution of bryophytes to moist habitats. The short rhizoids do not penetrate the soil very far and do not absorb nutrients. The lack of vascular and the associated supporting tissues also restrict the size of bryophytes.

The life cycle of bryophytes is characterized by a distinct alternation of generations, but differ from vascular plants in having the gametophyte as the predominant vegetative phase. Refer to demonstration material in the lab or Figure 29.8 on p. 607 in your lecture text for the life cycle of a typical moss. Examine the live and dried demonstration material available in lab.

Examine the slide of the moss *Mnium*. Note the absence of vascular tissues. The "leaves" have a mid-rib with cells that have thickened cell walls and function in support. Extending from the midrib is the blade of the leaf, often just a single cell in thickness. Cells of both the stem and leaves are photosynthetic. Make a sketch of your observations below.

SEEDLESS VASCULAR PLANTS: FERNS AND FERN ALLIES

The seedless vascular plants consist of four phyla: Pterophyta (ferns), Sphenophyta (horsetails and scouring rushes), Lycophyta (club mosses), and Psilophyta (whisk ferns). Between 300–400 million years ago, during the Devonian and Carboniferous periods, seedless vascular plants were the dominant form of terrestrial plant life. They were tree size plants and formed large forests. Most of the earth's coal deposits are the fossilized remains of these forests. A few living forms (tree ferns) may reach heights of several meters: however, most are relatively small.

Their vascular system connects the roots with shoots and true leaves. Vascular tissue consists of two types of cells: xylem and phloem. **Xylem** conducts most of the water and minerals up from the roots. It includes tube-shaped cells called tracheids. **Tracheids** are actually dead cells with only the cell walls remaining to form a microscopic system of tubes to transport the water and minerals from the roots throughout the plant. Non-vascular plants must rely on diffusion to move materials through the body, so the distance between photosynthetic and non-photosynthetic tissues must be small, limiting the size of the plant. **Phloem** consists of living cells arranged into tubes that conduct sugars, amino acids and other organic molecules from the site of production to the rest of the plant.

The cell wall of tracheids is often reinforced with the substance lignin. Lignified tissues provide much greater support to the plant and permit them to grow to larger sizes than bryophytes.

The dominant phase of the life cycle is the sporophyte. Refer to Figure 29.13 on page 611 in your lecture text and demonstration material for a typical fern life cycle. Note which parts of the life cycle are haploid and which are diploid.

Examine a prepared slide of the fern *Pteridium* rhizome cross section. The rhizome is an underground stem from which the fronds grow. The vascular tissues are scattered in islands in the central region of the cross section. Diagram the cross section in the space below. Identify the following: phloem, xylem, pith, cortex, epidermis, and endodermis.

Gymnosperms

Gymnosperms produce seeds on scale-like structures that form cones. Like ferns, the dominant phase of the life cycle is the sporophyte. You are already familiar with the sporophyte phase of gymnosperms, such as pines. It is the tree. Gymnosperms differ from ferns by being heterosporous, that is, they produce two morphologically different types of spores. Different types of cones produce the different spores. Examples of male and female cones are available on the demonstration table. Refer to Figure 30.6 on page 624 of your text for a typical pine life cycle.

Gymnosperms are cosmopolitan and include four phyla: Cycadophyta, Ginkophyta, Coniferophyta, and Gnetophyta. Cycads consist of approximately 100 species of plants that resemble palms. They are primarily tropical in distribution. The Phylum Ginkophyta is monotypic (single species). *Ginko biloba* is extinct in the wild and would have vanished if it had not been cultivated in ancient Japanese and Chinese gardens. *G. biloba* is renowned for its hardiness having survived everything from urban smog and road salt to an atomic bomb blast (Hiroshima). During the 1970's hundreds of cities across the country planted these ornamental trees. The popularity rapidly decreased once these trees matured and started to reproduce. Unlike other gymnosperms, female *G. biloba* don't produce cones, but large fleshy fruits that resemble cherries. When the fruits fall from the trees they create a slippery mess. To make matters worse, the butyric acid contained in the pulp gives the ripe fruit an aroma reported by some as resembling rotten eggs or vomit. *Ginko* is popular in this area. Several grow on campus northwest of Jesse Hall. You can easily spot them in the fall when the leaves turn a brilliant yellow. Gnetophytes are a small group consisting of three genera scattered around the world. One form *Ephedra*, consists of approximately 40 species of desert shrubs that grows worldwide and is the only gnetophyte native to the United States. *Ephedra*, also called Mormon tea, was used extensively as an herbal supplement until unfortunate and frequent side effects prompted the FDA to remove it from the market place.

The majority of gymnosperms belong to the conifers. Approximately 600 species are known to science. They include both the oldest, bristlecone pine over 5000 years old, and the largest living organisms, giant sequoias weighing over 3000 metric tons. Conifers include the pines, redwoods, juniper, fir, spruce, and cypress trees. Most conifers are evergreens, retaining their leaves throughout the year. This permits photosynthesis on any sunny day, even in winter.

In this exercise we will study the pine (*Pinus*), a widely distributed and economically important group of conifers. Pines are an important source of lumber, wood pulp, resin, pine tar and turpentine. Examine the slide of a cross section of a young pine stem and make a drawing of your observations in the space below.

Flowering Plants

Flowering plants or angiosperms (Phylum Anthophyta) are the largest, most speciose and wide spread of all plant groups. They owe much of their success to structural diversity, efficient vascular systems, short generation times and numerous mutualistic relationships, especially with insects and fungi. Angiosperms are extremely important to humans because they are a source of food, building material, clothing, and energy.

Biologists divide flowering plants into two classes:

Class Monocotyledonae or "monocots" includes grasses (such as corn and wheat), sedges, lilies, and bromeliads (such as pineapples), and palms. Some 65,000 species of monocots are now recognized.

Class Dicotyledonae or "dicots" contains cacti, peas and beans, most trees and most other garden vegetables. Dicots are very speciose—some 250,000 species have been identified.

Examine the demonstration material and be able to list the characteristics of each class.

Flowering plants possess the same tissues; however, the arrangement pattern differs between the two classes. Examine microscope slides of monocot (corn) and dicot (sun flower) stems comparing the internal organization. Make sketches of your observations on your worksheet noting key differences between the two.

Flowers are the main structures that are used by taxonomists to identify an angiosperm species. This is because floral structures within a genus and family don't vary much, but floral structures between different families typically are very different. In contrast, the appearance of leaves and stems are highly variable within families, so they can be deceptive or misleading when used as taxonomic tools.

Lily blossoms and sunflowers are anatomically **complete**, that is, they have all of the sexual and nonsexual parts, so they are said to be **bisexual** or **hermaphroditic (monoecious)**. On the other hand, maple trees, palms, and spinach are more like humans: some individuals are male with **staminate** flowers and others are female with **pistilate** flowers. This condition is called **dioecious**. But there are species that are intermediate between these extremes. For example each corn plant, pumpkin vine, and oak tree produces both staminate and pistilate flowers on different parts of the same plant. Sex in plants is far more exciting and varied than most folks think it is. For example, a few plants have their flowers located down in the dirt or beneath the water in a pond.

Objective: To learn about the structures of flowering plants, their flowers and fruits.

Procedure:

The array of leaves, stems, flowers and fruits produced by plants is immense, wonderful, and often beautiful. Just look at the bounty in provided for you in this lab—photos and specimens representing select plant families are on display. Think of it later on as you visit the produce and floral sections of a supermarket. Not one of us can truly comprehend the global diversity of plant structures, but their grace and elegance continues to inspire us as it has inspired humans since the dawn of time.

Take a single flower to your bench and inspect it, first with the naked eye and then using a dissecting microscope. Make a drawing of its structures on the worksheet, labeling each part. Use Figure 60A in your photo atlas for reference. Because the flowers available usually vary seasonally, your specimen may or may not be anatomically complete.

Examine the various fruits and seeds on display. By definition, a **seed** consists of three things: the embryo, its stored food supply, and a protective outer coating. The primary function of a seed is to protect and nurture the embryo until it can grow into a living plant. Some seeds found in ancient burial tombs in Egypt or caves in Mexico and Chile have remained viable after thousands of years.

Most seeds are embedded in a **fruit**, which is derived from ovarian [female] tissue that undergoes growth and maturation. One of the major functions of a fruit is to ensure dispersal of one or more seeds to new habitats, in other words, to promote gene flow and perpetuation of the species.

The seeds of many plants are dispersed by wind; while some are carried by flowing water, and birds and mammals carry others, either internally or externally. For example, when you eat a tomato or a cucumber, you are in reality becoming part of a mutualistic symbiotic relationship: you feed on nutrients provided by the plant while at the same time you ingest and then spread seeds of these species in your feces for propagation in new places. [Unfortunately from the standpoint of the plant, modern toilets and sewage systems disrupted with this cooperative arrangement.]

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LABORATORY UNIT 3 WORKSHEET [20 pts]

1. Make a drawing of yeast cells illustrating the process of budding. [1 pt.]

2. List the similarities and differences between fungi and protists. How do both of these kingdoms differ from the kingdom Eubacteria? [2 pts.]

3. Contrast the cellular organization of a moss and fern stem, relating structure to function in both plants. [2 pts.]

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LABORATORY UNIT 3 WORKSHEET

4. In the space below, compare the support and other major tissues of monocot and dicot stems by drawing the key features you observed. Include a detailed drawing of one vascular bundle from each. Label the epidermis, vascular bundle, xylem, phloem, and the sclerenchyma of the rind and bundle sheath. [6 pts]

5. In the space to the right, make a drawing of the flower you examined. Label the parts of the flower (pedicel, sepal, petal, stamen, pistil). [3 pts.]

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LABORATORY UNIT 3 WORKSHEET

PRACTICAL PLANT CLASSIFICATION

The process of identifying an organism can be accomplished using a **dichotomous key**. A dichotomous key consists of a series of two alternative characteristics, called **couplets**, which are compared to the traits of the unknown subject. Use of a key involves movement through a series of couplets, selecting one of the alternatives that best fit the characteristics of the object under study at each point along the way. Use the following dichotomous key to identify the four trees in the set given to you by your teaching assistant. (Write your identifications in the appropriate space at the bottom of this sheet.)

1. Leaves needle-like 2
   Leaves broad and flat 4
2. Leaves solitary .... Norway spruce, *Picea abies*
   Leaves in clusters of 2 or more leaves 3
3. Leaves in clusters of 2, <7 cm long .... short-leaf pine, *Pinus echinata*
   Leaves in cluster of 3–5, >7 cm long .... white pine, *Pinus strobus*
4. Leaves simple (i.e., one leaf arises from main stem) 5
   Leaves compound (i.e., composed of several leaflets) 6
5. Edge of leaf with several deep lobes 7
   Edge of leaf without deep lobes .... basswood, *Tilia americana*
6. Fewer than eleven leaflets .... shagbark hickory, *Carya ovata*
   Eleven or more leaflets .... black walnut, *Juglans nigra*
7. Lobes rounded .... white oak, *Quercus alba*
   Lobes pointed .... red maple, *Acer rubrum*

simple leaf compound leaf leaf with deep lobes

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LABORATORY UNIT 3 WORKSHEET

6. Identify the four tree species in your set [4 pts]:

   Which set did you examine? (Write the number for credit): ____________

	Genus	Species	Common name
a)	______	______	______
b)	______	______	______
c)	______	______	______
d)	______	______	______

7. Using common sense, explain why leaves are used in the key to identify the plants instead of flowers. [1pt]

8. Coconut palms have heavy fruits, as you saw today. Yet palms are found naturally on many remote tropical islands, often hundreds of miles from other islands and the mainland, far out in the Pacific or Indian Ocean. How did coconuts get there in the first place, long before a human visited this speck of land in a vast ocean? [1 pt]

LABORATORY UNIT 4
BIODIVERSITY III: ANIMAL DIVERSITY

All animals are multicellular, heterotrophic eukaryotes. The range of variation in form and function within the animal kingdom is incredible. Some people regard this situation with dismay, while others see beauty and wonder in the richness of animal life on Earth. Taxonomists estimate there are somewhere between 30 and 100 million species of animals dwelling on land. Recently marine biologists have discovered so many new, often bizarre forms living deep in the abyss that they claim there may be millions of additional animal species in the oceans.

The tens, if not hundreds, of millions of animal species are placed carefully into hierarchical taxonomic groups (Genera, Families, Orders, Classes, and Phyla) based on shared characteristics. Currently there are approximately 35 different animal phyla recognized. In this lab we will focus on several major animal phyla.

Work in groups of 4. Each group will be given four specimens representing different phyla. The specimen you get will be identified by its scientific name (genus and species name or in some cases just a genus) and phylum. Each student will select one of the animal specimens that he/she will research and then present this information to the class during the next lab meeting.

Objectives:

1. To become a "paraexpert" on the biology of one animal species.
2. To present a short synopsis of the biology of this species to the class.

Procedure:

Do not remove the animal specimens from the lab. You are to choose one species from the set of four given to your group. To learn about your animal, you will need to use a variety of resources that are available on campus. The best location for printed references is the book collection in Ellis Library. You can use "Merlin™" on MU-linked computers to search for books in Ellis and all other MU libraries. If you cannot find your species mentioned explicitly in a resource, then assume information about its taxonomic Family, Class, Order, or Phylum is also correct for your particular species.

In addition, you may also search electronic databases and to perform a subject search on the World Wide Web. [Do not use Wikipedia as a source! The information has not been reviewed for accuracy.] Regardless of the source, it is recommended that you verify the information you gather by checking multiple references. When finished, you should cite at least four sources (a maximum of two electronic) of information that proved useful.

Materials:

Per group of 3–4 students:
4 labeled, preserved animal specimens

ANIMAL BODY PLANS

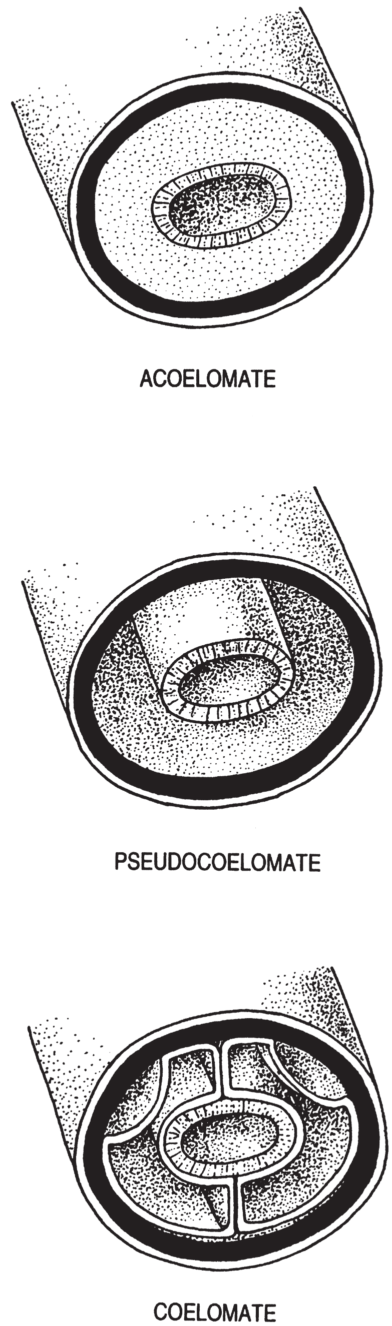
Biological levels of organization compose a hierarchical system, that is, each successive level builds on the one below it. This organization of the living world represents increasing complexity from the atomic level up to the all-encompassing biosphere. The animal body plans fall into the "cellular-tissue-organ-organ system" levels. At the **cellular level** of organization, animals are composed of aggregates of unspecialized cells. Each cell in the organism can perform all of the functions necessary for life. Cells of animals differ from those found in plants and fungi by lacking the structural support of a cell wall.

As the complexity of the animal body plan increases groups of cells differentiate. At the **tissue level** these groups of cells become specialized to perform a specific function (e.g. contraction of muscle tissue) more efficiently than the unspecialized cell. These specialized cells are typically isolated from other tissues by a membrane. At the **organ level**, two or more tissue types are combined to produce a structure capable of completing a complicated task (e.g. chemical breakdown of food). In the **organ system level** of organization two or more organs act synchronously to perform a multistage task (e.g. ingestion, breakdown and absorption of food, egestion).

Animals may also be categorized by their body symmetry. The simplest animals have irregular growth patterns and are classified as **asymmetrical**. **Radial symmetry** is found in animals that have a central axis. Any slice made through the central axis will divide the animal into two mirror images. Radial symmetry is found in the Cnidarians and Ctenophorans. The most complex body arrangement is **bilateral symmetry**. In bilaterally symmetrical animals there is only a single slice though the body that would produce two mirror images. Most animals exhibit bilateral symmetry. This body organization gives the animal distinct top and bottom, as well as, a front and back. Many free-living bilateral animals also show a concentration of nervous and sensory structures at the anterior (front) end of the body, called **cephalization**. By concentrating sensory structures, the animals are able to collect as much information as possible about the environment they are entering.

With the exception of the sponges, all animals are composed of different tissues. The tissues are derived from germ layers formed during embryonic development (see Figure 32.2 in your lecture text). All embryos begin as a single fertilized egg and undergo a series of cell divisions to form first a solid ball of cell, then a hollow ball (**blastula**) of cells. An invagination of the blastula wall forms a cavity called the **archenteron** with the opening to the outside called the **blastopore**. During this stage, called the **gastrula**, the archenteron continues to grow, eventually forming a hollow sphere with walls made up of two or three germ layers. If two germ layers (ectoderm and endoderm) are formed, the animal is **diploblastic**. If a third layer, the mesoderm, forms between the ectoderm and endoderm, the animal is **triploblastic**. Each germ layer will form specific tissues and structures in the post-embryonic animal. **Ectoderm** will give rise to the skin, surface glands, body coverings and most nervous and sensory structures. **Endoderm** gives rise to the gut and associated organs and reproductive organs. **Mesoderm** will give rise to connective tissues, muscle, internal skeletal systems, and circulatory systems.

Most triploblastic animals have a fluid-filled central body cavity between the body wall and gut (Figure 4.1). If the body cavity is formed completely within the mesoderm, the animal is classified as **eucoelomate**. Some small animals have body cavities that are only partially lined by mesoderm, usually on the inside of the body wall. These animals are



BODY PLANS OF BILATERAL ANIMALS

Figure 4.1 Triploblastic animal body plans.

called **pseudocoelomates**. If the central cavity is filled with loosely packed cells, the animal is **acoelomate**.

What is the advantage of having an open central cavity? The body cavity provides space for the enlargement of tubular organs, such as the digestive system or reproductive system. The elaboration of the systems permit increased efficiency or output. The enclosed fluid filled cavity also acts as a hydrostatic skeleton.

A final milestone in the animal diversification is the presence of segmentation. True segmentation, also known as metamerism, is the serial repetition of body parts. Development of segmentation is a precursor to regional specializations of the body, such as the modification of groups of segmental appendages to manipulate food, capture prey or for locomotion.

Name: ______________________
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Date: ______________________

LABORATORY UNIT 4

ANIMAL DIVERSITY WORKSHEET [20 pts.]

SPECIES NUMBER ___________

Profile of Your Species

Names

Latin Name: __________________ ______________________

Common Name: ______________________

1. **Taxonomic Information**

Phylum: __________________ Total species in Phylum: ______________

Class: __________________ Common Name of Phylum: ____________

Order: __________________

Family: __________________

2. **Morphological Information**

Biological Level of Organization: ______________________________________

Embryonic Germ Layers: ______________________________________

Symmetry: ______________________________________

Type of Body Cavity: ______________________________________

Segmentation: ______________________________________

Body Covering: ______________________________________

Skeleton: ______________________________________

Appendages/Locomotion: ______________________________________

Name: ______________________
Date: ______________________

LABORATORY UNIT 4

ANIMAL DIVERSITY WORKSHEET

Profile of Species—continued

Latin Name: ____________________ ______________________

3. Ecological Information

Distribution: ______________________

Habitat: ______________________

Food Habits (prey, capture technique): ______________________

Defense: ______________________

Social system/dispersion pattern: ______________________

Life History: ______________________

Name: ______________________
Date: ______________________

LABORATORY UNIT 4

ANIMAL DIVERSITY WORKSHEET

Profile of Species—continued

Latin Name: __________________ ______________________

4. **Physiological Information** (If your species lacks any of the systems, explain how they perform the physiological functions.)

Nervous System/Sensory Structures: ______________________

Respiratory System: ______________________

Circulatory System: ______________________

Digestive System: ______________________

Excretory System: ______________________

Reproduction/Parental Care: ______________________

Name: ____________________

Date: ____________________

LABORATORY UNIT 4

ANIMAL DIVERSITY WORKSHEET

Profile of Species—continued

Latin Name: ________________ ____________________

5. **Give one interesting aspect of the behavior or ecology of this species.**

6. **Citations/Sources of Information** (a maximum of two citations may be from internet sources)
   1.
   2.
   3.
   4.
   5.

Phylum **Porifera**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Cnidaria**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Ctenophora**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Platyhelminthes**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Nematoda**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Nematomorpha**
Symmetry: ______
Body Cavity: ______
Distribution: ______
Skeleton: ______
Circulatory: ______
Excretory: ______
Level of Organization: ______
Number of Germ Layers: ______
Segmentation: ______
Habitat: ______
Respiration: ______
Nervous System: ______
Reproduction: ______

Phylum **Acanthocephala**
Symmetry: ______
Body Cavity: ______
Distribution: ______
Skeleton: ______
Circulatory: ______
Excretory: ______
Level of Organization: ______
Number of Germ Layers: ______
Segmentation: ______
Habitat: ______
Respiration: ______
Nervous System: ______
Reproduction: ______

Phylum **Rotifera**
Symmetry: ______
Body Cavity: ______
Distribution: ______
Skeleton: ______
Circulatory: ______
Excretory: ______
Level of Organization: ______
Number of Germ Layers: ______
Segmentation: ______
Habitat: ______
Respiration: ______
Nervous System: ______
Reproduction: ______

Phylum **Tardigrada**
Symmetry: ______
Body Cavity: ______
Distribution: ______
Skeleton: ______
Circulatory: ______
Excretory: ______
Level of Organization: ______
Number of Germ Layers: ______
Segmentation: ______
Habitat: ______
Respiration: ______
Nervous System: ______
Reproduction: ______

Phylum **Mollusca**
Symmetry: ______
Body Cavity: ______
Distribution: ______
Skeleton: ______
Circulatory: ______
Excretory: ______
Level of Organization: ______
Number of Germ Layers: ______
Segmentation: ______
Habitat: ______
Respiration: ______
Nervous System: ______
Reproduction: ______

Phylum **Brachiopoda**

Level of Organization: ____________

Symmetry: ____________

Number of Germ Layers: ____________

Body Cavity: ____________

Segmentation: ____________

Distribution: ____________

Habitat: ____________

Skeleton: ____________

Respiration: ____________

Circulatory: ____________

Nervous System: ____________

Excretory: ____________

Reproduction: ____________

Phylum **Annelida**

Level of Organization: ____________

Symmetry: ____________

Number of Germ Layers: ____________

Body Cavity: ____________

Segmentation: ____________

Distribution: ____________

Habitat: ____________

Skeleton: ____________

Respiration: ____________

Circulatory: ____________

Nervous System: ____________

Excretory: ____________

Reproduction: ____________

Phylum **Onychophora**

Level of Organization: ____________

Symmetry: ____________

Number of Germ Layers: ____________

Body Cavity: ____________

Segmentation: ____________

Distribution: ____________

Habitat: ____________

Skeleton: ____________

Respiration: ____________

Circulatory: ____________

Nervous System: ____________

Excretory: ____________

Reproduction: ____________

Phylum **Arthropoda**

Level of Organization: ____________

Symmetry: ____________

Number of Germ Layers: ____________

Body Cavity: ____________

Segmentation: ____________

Distribution: ____________

Habitat: ____________

Skeleton: ____________

Respiration: ____________

Circulatory: ____________

Nervous System: ____________

Excretory: ____________

Reproduction: ____________

Phylum **Echinodermata**

Level of Organization: ____________

Symmetry: ____________

Number of Germ Layers: ____________

Body Cavity: ____________

Segmentation: ____________

Distribution: ____________

Habitat: ____________

Skeleton: ____________

Respiration: ____________

Circulatory: ____________

Nervous System: ____________

Excretory: ____________

Reproduction: ____________

Phylum **Hemichordata**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum **Chordata**
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______

Phylum
Level of Organization: ______
Symmetry: ______
Number of Germ Layers: ______
Body Cavity: ______
Segmentation: ______
Distribution: ______
Habitat: ______
Skeleton: ______
Respiration: ______
Circulatory: ______
Nervous System: ______
Excretory: ______
Reproduction: ______